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INVESTIGATION OF HOP MOSAIC DISEASE IN THE FIELD

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(With 2 Text-figures.)

DURING the years 1923-5 field observations of Hop Mosaic were carried out to study more fully the symptoms of the disease, to follow more completely its spread under commercial conditions, and at the same time to determine how far the disease can be controlled by the prompt grubbing of diseased plants. These observations, made in a number of gardens in various parts of Kent, extended over the three years, and the following is a summary of some of the results that may be of interest on the practical side.

INFECTIOUS NATURE OF THE DISEASE.

In the garden *B*, where the disease was rampant, a study of the position of diseased hills occurring during the three years, shows that although plants far removed from other diseased plants may develop the disease, yet in general the disease clearly spreads from areas which have been occupied by such plants.

The history of this garden was interesting. A small portion in the middle of the field of Tutsham plants had been planted with certain seedlings (*M.* 45, etc.) and the following year a big outbreak of Mosaic Disease occurred among the Tutshams surrounding the imported seedlings. The seedlings and the diseased plants were grubbed during the following winter (1922-23).

The position of those seedlings was the centre of the area which embraced nearly all the cases of Mosaic Disease found during the three years of observation (see Fig. 1, p. 231).

All the evidence collected shows that the disease was introduced to that garden by these seedling varieties which did not themselves show the disease (carriers).

As regards observations in the other gardens they, too, gave support to the view that the Mosaic Disease of hops is an infectious disease, as grafting experiments have since shown.

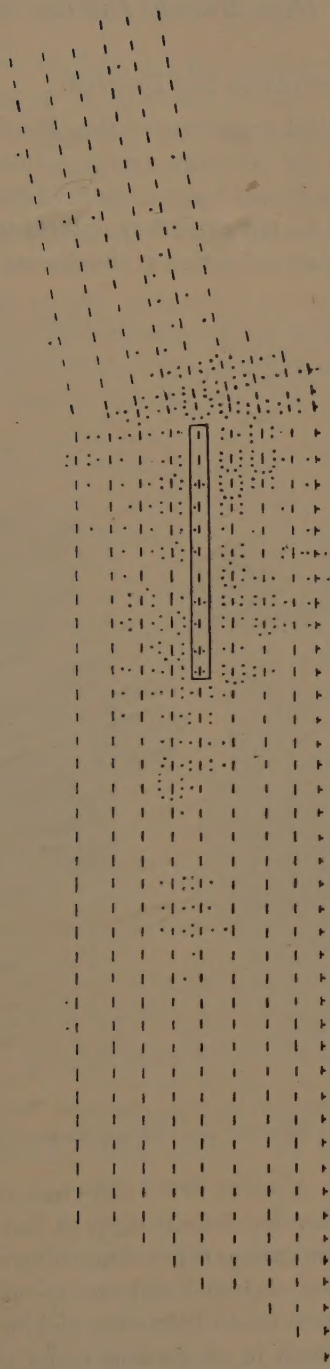


Fig. 1. Plan of garden B showing the position of hop plants developing Mosaic Disease during the years 1923-5. The diagram is approximately to scale. Each dot represents a single diseased plant. Each *short* line signifies 16 hop plants, and each *long* line 12 hop plants. The portion enclosed in the rectangle is that area in which certain seedlings, not Tutsham, were planted in 1921. One or more of these seedlings was a carrier of the disease. The other plants in this garden are all of the Tutsham variety.

SYMPTOMS OF THE DISEASE.

The detection of the initial symptoms of Hop Mosaic presented considerable difficulty. Plants did not show symptoms until they attained the height of 3-4½ ft. Even diseased plants marked down and specially watched the following year did not exhibit symptoms until they reached that height. As a rule, the first indication of the disease was found in the



Fig. 2. Photograph of two shoots from the same plant (var. Tutsham). Left: the normal shoot. Right: deformed shoot from a diseased lateral.

leaves at the tip of the plant. A period of 5-7 days was quite sufficient for a plant hitherto normal to develop definite signs of bad Mosaic Disease.

Throughout the three years various types of mottling were encountered in all the gardens. They were classified and one special type is of importance. In 1923, two or three weeks before the picking, a big outbreak of this particular type appeared in all gardens under observation. The

mottling occurred, as a rule, on a few short laterals (usually no more than three) at the head of an otherwise perfectly normal plant. When these laterals bore hops, the cones were deformed and undersized (Fig. 2) and, in some cases, the mottled laterals died back at the tips.

Thirty-three cases of this mottling were found in one garden. The following year (1924) 21 were badly affected with Mosaic Disease; the remaining 12 were normal. In 1925 one of the 12 showed bad Mosaic Disease, while the 11 continued healthy in appearance.

In another garden, 30 cases of this same mottling were marked down for observation. In 1924, 20 developed definite Mosaic and were grubbed, 9 were normal, and 1 was suspect. The following year all 10 were normal.

The same type of mottling was found in 1924, and 10 cases found in one garden were watched. The following year 6 of them developed definite Mosaic Disease; the remaining 4 were normal.

These figures indicate that two-thirds of the plants showing this symptom one year will have Mosaic Disease the following year. The remaining third may be quite normal for the second and third years, or in a very few instances show definite Mosaic symptoms in the third year. The longest time any of these "mottled" plants may remain normal in appearance in succeeding years, whether any ultimately recover or whether they retain the latent form of the disease, has not yet been determined.

It should be stated that a large number of bad cases of Mosaic occurring in 1924 were perfectly healthy in 1923.

There is no doubt that this disease can be present in an apparently healthy plant of a susceptible variety, as the history of the following case shows.

1923. A one-year old plant.

June 8.	Regarded as a suspect.
July 6-8.	Definite <i>Mosaic Disease</i> .
Aug. 2-5.	Improved considerably.
Aug. 30-Sept. 4-5.	<i>Quite normal</i> . No mottling on the laterals and the cones perfect.

1924.

May 5-8.	Normal (in any case too small for symptoms to appear).
May 15-18.	Normal.
June 11-12.	Suspect.

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1924.

July 25. *Definite Mosaic Disease.* It had a "grow away" tendency, but the disease had the upper hand. It bore a small crop of deformed cones associated with definite Mosaic mottling.

1925. *Definite Mosaic Disease.*

During conditions favourable for rapid growth diseased plants may produce growth free from disease symptoms, but they will not maintain the improvement after the conditions for rapid growth have passed¹.

EFFECT OF GRUBBING ON THE CONTROL OF THE DISEASE.

With our present knowledge of the symptoms of the disease, prompt grubbing carried out over a period of two years will not entirely stamp out the disease, but it will check the spread and, in some cases, reduce the amount of disease in the third year.

In the garden to which reference has already been made in regard to the introduction of the disease by certain special seedlings, grubbing appears to have done much good.

The figures are:

1923. 104 cases: grubbed, 74; the remaining 30 were some of those showing the special type of symptom referred to on p. 232.

1924. 260 cases (240 new): grubbed, 259 including 20 of the 30 left in from last year. One left by error.

1925. 18 cases (17 new): these included the one left in from 1924.

That the low figures for 1925 may be due to the season masking the disease does not seem likely, since a garden about 10 miles away was very badly attacked with Mosaic Disease that year. Furthermore, an inspection in 1926 showed that the improvement was maintained.

In another garden of half the area where prompt grubbing was not carried out the figures for the three years are:

1923. 37 cases: grubbed, 4; 33 left in (all those showing the new symptom).

1924. 222 cases (201 fresh): grubbed, 164, about six months after the crop was harvested.

¹ This may account for a belief that a dressing of nitrate of soda will cure the disease. No cases were observed to recover permanently, and no correlation between manuring and incidence of the disease could be established.

1925. 83 cases (about 30 new): these included about 50 of those left in from 1924.

Unfortunately a strict comparison of this small garden with garden *B* is not allowable, since in the small garden there is the possibility that part of the garden had been planted with stock infected with a latent form of the disease, and further, a badly infected garden adjoined it, although that garden was being rogued of the disease.

RECOMMENDATIONS.

The disease is infectious in the field and for that reason prompt grubbing is to be recommended.

Prompt grubbing carried out for a period of two years will not stamp out the disease but will hold it in check.

Where a grower decides to rogue his garden of diseased plants he should examine the plants at least twice in the season; firstly when the plants are about 4–6 ft. high (*i.e.* at the breast wire in the Butcher System of training), and a second time two or three weeks before the picking.

Growers should be extremely careful to avoid the importation of “carrier” plants into their gardens.

Growers should avoid taking sets from infected gardens, also in infected gardens the practice of filling up gaps with cuttings from neighbouring hills cannot be too strongly condemned, as the disease may be present in a plant which is perfectly normal in appearance.

(Received August 19th, 1928.)

